WHAT IS CLAIMED IS:

1. A method for preparing multicrystalline substrates as handling wafers for subsequent bonding to device layer materials, the method comprising the steps of:

providing an initial multicrystalline substrate;

polishing the multicrystalline substrate to reduce surface roughness to about 5 nm;

forming a filler layer overlying the face of the substrate to a predetermined thickness, the filler layer comprising a surface that is substantially free from indications of the multicrystalline arrangement; and

further polishing the surface of the filler layer to form a substantially smooth upper surface on the substrate,

wherein the substantially smooth upper surface is characterized by a surface roughness of twenty Angstroms or less.

2. The method of claim 1, wherein the initial substrate is selected from a polycrystalline silicon wafer, a glass substrate, a ceramic substrate, an organic film, a metal substrate, and an amorphous wafer.

3. The method of claim 1, wherein the initial substrate has a typical crystalline dimension of about 0.5 to 10 millimeters in size.

4. The method of claim 1, wherein the filler layer is selected from a CVD oxide, and a polycrystalline silicon.

5. The method of claim 1, wherein the filler layer is removed to a thickness of one half or more of the predetermined thickness.

6. The method of claim 1, wherein the filler layer is a polycrystalline silicon, the polycrystalline being formed using a low pressure chemical deposition technique.

7. The method of claim 1, wherein the filler layer is chosen from the group consisting of an insulating layer andor a composite layer.

8. The method of claim 1, wherein the surface roughness is five Angstroms or less.

9. The method of claim 1, wherein the filler layer is made by a chemical deposition process or a sputtering process.

10. The method of claim 1, wherein the substrate is a ground substrate or unpolished substrate.

11. The method of claim 1, wherein the polishing process is a chemical mechanical polishing technique comprising:

applying a mechanical fine-grinding step;

applying a rough polishing step using a weakly alkaline slurry;

changing the composition of the slurry by feeding a neutral polishing slurry to the polishing pad and gradually reducing supply of rough polishing slurry; and

wherein surface roughness after polishing is 0.5 nm or less.

12. The method of claim 1, wherein the polishing process is a chemical mechanical polishing comprising:

applying a mechanical fine-grinding step;

applying a rough polishing step using a weakly alkaline slurry;

adding TMAH to the slurry to adjust the alkalinity of the slurry for increased removal rates while maintaining material removal rates relatively constant between various grain regions of the substrate; and

effecting a controlled transition to a second slurry composition to obtain microscopically smooth surfaces;

wherein surface roughness after polishing is 0.5 nm or less.

13. The method of claim 1, wherein the polishing process is a double-sided chemical mechanical polishing technique comprising:

applying a mechanical fine-grinding step;

applying a rough polishing step using a weakly alkaline slurry;

changing the composition of the slurry by feeding a neutral polishing slurry to the polishing pad and gradually reducing supply of rough polishing slurry; and

wherein surface roughness after polishing is twenty Angstroms or less.

14. The method of claim 1, wherein the polishing process is a double-sided chemical mechanical polishing technique in which polishing is done on a double-sided polishing machine to polish front and back sides of the substrate simultaneously, comprising:

applying a mechanical fine-grinding step;

applying a rough polishing step using a weakly alkaline slurry;

adding TMAH to the slurry to adjust the alkalinity of the slurry for increased removal rates while maintaining material removal rates relatively constant between various grain regions of the substrate;

effecting a controlled transition to a second slurry composition to obtain microscopically smooth surfaces;

wherein the front and back side each achieve a flatness of 0.5 micron or less; and

the front side achieves a roughness of 0.5 nm or less.

15. Electronic devices made from bonded assemblies prepared using the method of claim 1.

16. Micro-Electro-Mechanical Structures (MEMS) made from bonded assemblies prepared using the method of claim 1.

17. Micro-Opto-Electro-Mechanical Structures (MOEMS) made from bonded assemblies prepared using the method of claim 1.

18. A method for polishing substrates, the method comprising steps of:

applying a rough polishing step using a weakly alkaline slurry;

changing the composition of the slurry by feeding a neutral polishing slurry to the polishing pad and gradually reducing supply of rough polishing slurry; and

wherein surface roughness after polishing is 0.5 nm or less.

19. The method of claim 18, wherein the polishing is performed on a double-sided polishing machine to polish front and back sides of said substrate simultaneously.

20. Electronic devices made from bonded assemblies prepared using the method of claim 18.

21. Micro-Electro-Mechanical Structures (MEMS) made from bonded assemblies prepared using the method of claim 18.

22. Micro-Opto-Electro-Mechanical Structures (MOEMS) made from bonded assemblies prepared using the method of claim 18.

23. A method for detection of hidden bonding flaws in multiple bonded wafers, the method comprising steps of:

transmitting infrared radiation through a first side of a multiple bonded wafer sample;

receiving the scattered infrared radiation exiting from a second side of said sample, said second said being opposite from said first side; and

converting said received radiation into an electronic signal in which defects appear as local maxima of said signal.